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ABSTRACT

While proficiency in academic writing and communication skills, such as teamwork, are seen as desirable graduate outcomes in higher education, they have taken a secondary place to the teaching of specific disciplinary knowledge within curricula. Traditionally, writing, such as writing a researched report, has been a source of anxiety for students at all levels. Academic and professional expectations, unfamiliarity with the conventions of research writing, limited exposure to report writing and writing proficiency have contributed to this. Similarly, teamwork has presented students and lecturers with a myriad of difficulties from the development interpersonal skills to assessment. This paper presents an innovative 1st-year topic designed to integrate the learning of academic and communication skills with disciplinary knowledge in engineering. The three modules comprising the topic are discussed with a focus on the key module, Language in Use (LIU). LIU is focused on developing the skills necessary to enable students to become more successful researchers, writers and team participants in the context of engineering. The LIU curriculum presents a holistic approach to learning in which the teaching of academic and communication skills as well as disciplinary knowledge are embedded into the curriculum design. Furthermore, the curriculum is designed to connect students, lecturers and industry participants in order to support the development of writing and teamwork skills on authentic engineering tasks. Factors identified by lecturers and learners as contributing to the curriculum's success in facilitating the learning process and resulting in a higher degree of student and lecturer satisfaction are also presented. (Contains 12 references and 3 tables.) (Author/RS)

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Facilitating the development of disciplinary knowledge and communication skills: Integrating Curriculum

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ABSTRACT: While proficiency in academic writing and communication skills, such as teamwork, are seen as desirable graduate outcomes in higher education, they have taken a secondary place to the teaching of specific disciplinary knowledge within curricula. Traditionally, writing, such as writing a researched report, has been a source of anxiety for students at all levels. Academic and professional expectations, unfamiliarity with the conventions of research writing, limited exposure to report writing and writing proficiency have contributed to this. Similarly, teamwork has presented students and lecturers with a myriad of difficulties from the development interpersonal skills to assessment. The following paper presents an innovative 1st-year topic designed to integrate the learning of academic and communication skills with disciplinary knowledge in engineering. The three modules comprising the topic are discussed with a focus on the key module, Language in Use (LIU). LIU is focussed on developing the skills necessary to enable students to become more successful researchers, writers and team participants in the context of engineering. The LIU curriculum presents a holistic approach to learning in which the teaching of academic and communication skills as well as disciplinary knowledge are embedded into the curriculum design. Furthermore, the curriculum is designed to connect students, lecturers and industry participants in order to support the development of writing and teamwork skills on authentic engineering tasks. Factors identified by lecturers and learners as contributing to the curriculum's success in facilitating the learning process and resulting in a higher degree of student and lecturer satisfaction are also presented.

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INTRODUCTION

While proficiency in academic and communication skills are seen as desirable graduate outcomes in higher education, they have presented difficulties in terms of gaining space for focussed instruction in curriculum. The difficulties that are often associated with gaining curriculum time stem from valid constraints related to the prioritization of teaching disciplinary knowledge over generalisable strategies for academic success. In addition, teaching students how to write researched reports and participate as responsible group members are in themselves specialised areas of learning. As a result of the absence of dedicated instruction on academic writing and team skills, 1st year students often view the process of writing researched reports and working on team projects as major challenges and consequently, sources of anxiety. Factors such as unfamiliarity with academic and professional standards, the conventions of researched report writing and poor team skills contribute to this. However, recent discussion on industry's view of desirable graduate qualities [1] as well as talk of testing graduate outcomes, for example, a Graduate Skills Assessment test (GSA) [2], have prompted a revisiting of the development of academic and communication skills in conjunction with disciplinary knowledge.

This revisiting has taken the form of graduate surveys and reviews of academic and communication skills in undergraduate courses. For example, Curtin University's Communication-in-Context policy promotes the development of programs and practices that aim to provide all graduates with academic and communications skills such as, a high degree of oral, writing, graphical, interpersonal and negotiating skills. In business, the Karpin Report (1995) [3] calls for postgraduate and undergraduate curricula to provide greater emphasis on communications and team building, concluding that managers need improved 'people skills'. This has recently been emphasised in an article by Kenihan [1] in which it is stated that "the small, task-orientated team is now the basic unit of work organisation, not the individual employee, and so communication skills are essential" (p. 2). Concern has also been expressed that existing undergraduate programs are not producing graduates with the kinds of professional skills which includes academic skills [4, 5, 6, 7, 8, 9, 10], and lifelong learning skills including communication skills [11, 12], that they need in order to be successful in their professions.

In response to the raised awareness of the now critical role academic and communication skills play not only in academic success but in the workplace, this paper will present a framework for the teaching of academic and communication skills in an integrated curriculum. The curriculum blends specific disciplinary knowledge, conceptual frameworks for engineering and the development of teamwork and the writing process in a concurrent approach.

TOPIC OVERVIEW

In order to begin addressing these factors, a core topic for 1st year engineers has been designed and implemented with a focus on the concurrent development of students' awareness of engineering as discipline, academic and communication skills, and specific disciplinary knowledge. The topic is a compulsory 1st semester topic for all commencing students in Engineering. The topic, *Team Project and Communication*, consists of three modules: Module 1, Introduction to Engineering Planning and Design; Module 2, Engineering Project; and Module 3, Language in Use.

1) Module 1: Introduction to Engineering Planning and Design

This consists of weekly lectures developing student's awareness of engineering as a discipline, engineering practices and frames of reference.

2) Module 2: Engineering Project

The Engineering project is the primary focus for the topic and is undertaken by students working in teams. It is generally aimed at conducting a feasibility study/assessment. There is a strong emphasis on project evaluation, planning, infrastructure development, industrial design, social and economic factors and environmental impact studies as discussed in Module 1, Introduction to Engineering Planning and Design. Project leaders, who are appointed from industry, draw on their experience and industry contacts to formulate the project topics and to facilitate the student groups. These groups meet with their project facilitator on a weekly basis.

3) Module 3: Language in Use

Language in Use is designed to support the development of a team researched report project and a team presentation of this report. Therefore, LIU teaches teamwork skills, research writing skills and evaluation skills. All of the tasks are focussed on and contribute to the team project through the development of interpersonal and professional practices in communicating as well as researching and report writing for engineers. LIU is a combination of lecture and workshop and meets for two-hours each week with students attending workshops in their project groups where possible.

LIU holds a pivotal position in relation to the other two modules. It is in LIU where academic and communication skills are taught, practiced and reflected on. In comparison, it is in Module 1 and 2 that the students are required to apply both communication skills in the process of teamwork and academic skills including but not limited to listening to lectures, note-making, and reading for academic purposes.

LANGUAGE IN USE

The design of the curriculum and the materials developed for LIU are key contributors to its overall success. This success is evidenced in student and teacher satisfaction with the process and the quality of the final product, the researched report. The following sections of this paper will discuss the design, process and significance of the LIU curriculum. Most importantly, LIU is an interactive course, in which students participate in a variety of ways. Students are required to:

- reflect on their past communicative experiences
- work out what they can do well already
- decide what areas they need to develop further
- interact with the other members of the class, team and teaching staff.

The course provides opportunities for students to extend their skills through a range of communication media:

- write a formal researched report, minutes for meetings, letters requesting information related to the topic and article reviews
- give informal and formal oral presentations both individually and as part of a team
- participate as a member of a team/group, both large and small
- read, analyse and comment on a range of information sources.

LIU aims to develop:

- an awareness of the use of the English language in the context of engineering
- skills in logical thinking, critical analysis and reflection as a means to enhance self directed, independent learning
- teamwork skills necessary for academic and professional practice
- researched report writing and presentation skills.

On completion of this topic, students should be better able to:

- present a set of logically related ideas in spoken and written format
- plan, draft and edit a range of written assignments
- reflect critically upon the viewpoints of others
- utilise language in professional and academic contexts

Design of LIU

The LIU curriculum takes an integrated approach to the development of disciplinary knowledge, academic skills and teamwork skills. The approach is structured to provide opportunities for students to apply the skills as they are introduced and to monitor their understanding of the processes of researched report writing and teamwork. The general procedure for the introduction of skills as shown in Table 1 and 2 is: 1) modeling the skills; 2) practicing on classroom tasks; and 3) applying to the authentic task. For example, the authentic task may involve the researched report or negotiating in the team context. Whatever form application takes, students are actively involved in the process. In this way, the LIU curriculum achieves its overall goal, which is, to introduce students to the processes of writing through the completion of a researched report and to facilitate the development of teamwork skills.

Table 1: An integrated approach for writing skills and disciplinary knowledge development

Context: Writing skills	
Introduce skills → Practice skills → Apply skills	
Acquisition of skills	*Acquisition of disciplinary knowledge*
• For example, narrowing a topic, taking notes from reading articles, paraphrasing, summarising, avoiding plagiarism, and using in-text citations.	• Writing a researched report in engineering. Topic definition and content selection is the responsibility of the student.

Table 2: An integrated approach for teamwork skills and disciplinary knowledge development

Context: Teamwork skills	
Introduce skills → Practice skills → Apply skills	
Acquisition of skills	*Application of skills*
• For example, chairing a meeting, taking minutes, turn taking in meetings, troubleshooting issues, resolving conflicts.	• Formal meetings, informal meetings, small group work. • Meetings with peers or staff or industry.

Tables 1 and 2 illustrate some of the relationships of communication skill, disciplinary knowledge and the context, which are developed within the curriculum. Disciplinary knowledge in Table 1 refers to the researched report requirements. Therefore, as students practice the skills by immediately applying them, and within this structure, they not only acquire writing skills but are developing an understanding of their topic. This is in contrast to an approach where, for example, skills are taught in a disassociated way in which the content and themes are not necessarily related to the authentic tasks. In order for the process of introduction, practice and application of skills to be successful, the timing is critical. Students need time to reflect on the process and to think about how best to apply the skills in order to complete the report.

Process

As can be seen in Table 3, the five-step curriculum is designed to build skills incrementally toward a team report and oral presentation. At the beginning of the course, model researched reports and samples of student work from previous semesters are provided. This includes an explanatory glossary for each step in order for students to gain a clear overview of the final product. The curriculum is conceptualized as follows:

Step #1: "Researching"

Students are assigned a team and the team assigned a general topic. The topic is then explored to get some idea of the possible parameters for the project. This is facilitated through teamwork including brainstorming and discussing ideas. Next, instruction is given on how to narrow the topic to a suitable and manageable research topic. After this, instructional time is spent on developing skills for searching and locating different types of resource materials such as, newspaper and magazine articles, government publications in the form of brochures and leaflets, journal articles and on-line publications. Finally, time is spent on allocating sections of the topic to team members and narrowing the topic perspective to an appropriate and informative title for the researched report/chapter. The end-task is to complete a letter requesting information related to the topic. Throughout this step, focussed instruction on aspects of teamwork is given, for example, group organisation and groups that work.

Step #2: "Planning and drafting"

The next step is for students to read the resource materials they have collected, take notes from the readings and develop a scratch outline for their chapter. During this step students receive specific instruction on plagiarism and how to avoid it through paraphrasing, summarising and the conventions of acknowledging other people's ideas and work. At the end of this stage students are required to have completed an article review and a draft of their chapter with a cover page, a clear title and a reference page formatted using an appropriate referencing style for engineering. The articles for reviewing are put forward by the project leader and are chosen because they are seminal articles in the areas of the topics the teams have undertaken. Both of the assessment tasks must show evidence of application of the skills introduced and practiced in class. Teamwork skills and the process of working together is explicitly addressed though discussion in class. Teams may also choose to meet with the LIU lecturer to discuss

strategies for dealing with concerns that emerge from the teamwork experience, for example, non-attendance of team members at meetings, unequal work distribution and lack of effort on key tasks. These issues are discussed as a class and the class is encouraged to take a problem solving approach in order to be able to suggest strategies for managing the situation(s).

Step #3: "Summarising and revising"

Students practice academic writing skills such as revising paragraphs focussing on the development of topic sentences, main ideas, supporting ideas and details. In order to complete the paragraphs, students need to use the skills of paraphrasing and summarising as introduced in Step #2. Furthermore, at this stage it is necessary for students to revise the introduction, structure the body of the paper through the development of paragraphs, and to revise the conclusion. Cohesive writing styles are addressed, and strategies for unity and logical consistency are focussed on. Students are encouraged to read further in their topic in order to develop the content of each main point and to check each main point for equal development within the paper.

Additionally, in order to meet the needs of researched reports in engineering, the use of graphics is introduced. This step involves the writing of descriptive, procedural or analytical passages that explain the graphic in relation to the point that is being made in the text. The assessable task for this step requires students to select or design a graph, table, diagram or chart related to their topic and write a cohesive paragraph. Alternatively, students may choose to write an abstract(s) for their individual chapter(s). The assessment tasks must show evidence of application of the skills introduced and practiced in class. At this stage of the semester, teamwork is supported through reflective discussion in class. Strengths and weaknesses of teamwork are identified, issues raised and a problem-solving approach to managing issues reinforced.

Step#4: "Compiling and fine tuning"

Next, the students edit their chapters. At this point, time is provided to use writing checklists and to allow for peer editing. Once the individual chapters are completed, the process of compiling the researched report commences. Students then need to edit the complete report and check for consistency of formats and conventions, for example, referencing style in text and on the reference page. Furthermore, an executive summary must be written for the complete report. The final report consists of a title page, abstract or executive summary, acknowledgments, table of contents, chapters, reference list, and appendices. The final report is assessed by both the project leader and the LIU lecturer and receives a team grade.

Step #5: "Presenting"

The final step in the process is for the teams to present their report to the class, the project leader, LIU lecturer, faculty from Engineering and guests. This is a formal team presentation, which is allocated approximately 45 - 60 minutes. The oral presentation allows for the recycling of the skills of note-making, outlining, summarising and paraphrasing as developed through the course and provides an opportunity for the

development of visual material to support the presentation. Assessment is by peers, project leader and LIU lecturer. There is also a follow-up interview as a team with the LIU lecturer where the oral is discussed and teamwork reflected on. Students are given opportunity to debrief and propose strategies that may aid them in future presentation situations.

Assessment

Because it is the process that is critical to the development successful teamwork, researching and report writing, the assessment for LIU reflects and reinforces this. The assessment is distributed over the 13 weeks of semester. Distributing the assessment of tasks over the semester also alleviated students' feelings of being overwhelmed by the end-task requirements, that is, the researched report and team presentation of it. The pattern of assessment in the topic can be seen in Table 3. The report is presented and assessed in chunks, with credit being given for each step as shown in Table 3. Students have responded positively to the assessment process of building credit as they progress, rather submitting a final paper at the end of the course, which carries all the weight of passing.

Table 3: Distribution of assessment

Credit	Requirements	Process
10%	Letter requesting information	Step #1 Researching
10%	Article review	Step #2 Planning & drafting
10%	Draft #1 Introduction, body and conclusion, in-text citations, reference list for individual chapter	
10%	Individual abstract (executive summary) for chapter(s) or, graphic with explanatory paragraph.	Step #3 Summarising and revising
30%	Final team report including, title page, abstract, acknowledgments, table of contents, chapters, reference list, appendixes	Step #4 Compiling and fine-tuning
30%	Team presentation of report (approximately 45 minutes)	Step #5 Presenting

Evaluation

Evaluation of both a formative and summative nature is present. Due to the step-by-step process in the design and progressive assessment formative evaluation is inherent in the curriculum structure. Likewise, summative evaluation in which the effect or impact of the curriculum can be measured is possible. The evaluation applies to both the students' learning and the curriculum design with reference to the aims and learning outcomes.

Firstly, through the incremental assessment and the reflective process embedded in the curriculum, students and the lecturer are able to monitor learning and modify teaching and task as necessary. Another key role of summative evaluation in the LIU curriculum is to support the students' independent efforts and place the responsibility and initiative in the process with them. This is particularly encouraged in the autonomy of structure and management of the project groups. Summative evaluation is possible by reflection on the quality of student work as evident in both the final report and the oral presentation and the overall success of student teamwork.

Secondly, in order to identify teaching and learning values that emerged from the process of designing and implementing the LIU curriculum as well as effectiveness in terms of the aims and learning outcomes, a range of ongoing methods for evaluation are present. In particular, teacher collaborative action is used as a formative indicator of the progress of teaching and learning. This involves weekly meetings between lecturers to fine-tune lesson content, discuss timing of classroom tasks, review methods to provide feedback to students, check time-frames for assignments due and address any problems such as assisting students to find reading resources. Additionally, class observations in the form of peer reviews of teaching during the semester as well as informal student feedback contribute to the formative component of evaluation. Summative evaluation through the Student Evaluations of Teaching (SET) is conducted at the end of semester. In addition, information is gained through a review of curriculum in light of the information the semester meetings reveal and also in the quality of the final reports and oral presentations.

Significance of the LIU module

The following are collaborative observations and evaluations of qualitative data identified as significant positive contributors to the curriculum design and learning process.

Significance

1. Topics relate to the students' interests means that the students are motivated to research and follow the topic through.
2. Since students are encouraged to be decision-makers at all steps of the writing process they develop a sense of ownership and demonstrate motivation.
3. By dividing the teaching of researched report writing into manageable sections, students experience less anxiety and feel less overwhelmed by the end-task requirement.

4. The development of students' disciplinary knowledge is supported in an integrated way by the three modules and therefore, students are not constantly grappling with new content material and skill development simultaneously.
5. The integrated nature of the approach not only provides time to practice a skill but also gives students an immediate authentic context for application.
6. Students' negative attitudes to academic writing and teamwork are challenged by the curriculum through fostering a mentoring climate.
7. The teams' final reports and oral presentations are successfully completed with a sense of students belonging to a 'professional'context.

CONCLUSION

Curriculum in which students learn only the 'what' of disciplinary knowledge without reference to how to learn or complete the process required for success in the topic is presumptuous. Curriculum needs to include direct reference to the development of those skills which act as vehicles for the display of knowledge, for example, by embracing how to communicate as well as research, write and format basic research reports is essential for development. The LIU curriculum is an attempt at integrating or blending strands in curriculum in a way that complements rather than detracts from the individual development of each. It is successful as a framework for developing communication skills and disciplinary knowledge concurrently. It is also successful as a collaborative teaching endeavour in so far as it is supported by two other modules that feed into the process of completing team projects in engineering as realised through a researched report and an oral presentation. In conclusion, graduate attributes is a theme that is with us. Curriculum must recognise them as valuable components to academic course work and professional readiness. Communication skills such as teamwork and professional writing enhance the quality of our graduates and prepare them for academic success and the workplace.

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